US Army Corps of Engineers
San Francisco District
CERTIFICATION FOR
INDEPENDENT TECHNICAL REVIEW
For
Santa Clara Valley Water District
Lower Peninsula Watershed Hydrology Report
Matadero, Baron, Adobe, Stevens, and Permanente Creeks*

COMPLETION OF QUALITY CONTROL ACTIVITIES

The Santa Clara Valley Water District has completed product development and technical review of the Santa Clara Valley Water District Lower Peninsula Watershed Hydrology Report, Revised July 2006. Certification is hereby given that all quality control activities associated with product development and Independent Technical Review (ITR), appropriate to the level of risk and complexity inherent in the product have been completed for the Matadero Ck, Barron Ck, Adobe Ck, Stevens Ck and Permanent Ck hydrologic analyses. The San Francisco District Water Resources Section performed the ITR; their certification statement is enclosed (enclosure 1). Enclosure 2 contains documentation of the quality control process.

GENERAL FINDINGS

Compliance with clearly established policy principles and procedures, utilizing clearly justified and valid assumptions, has been verified for the subject report. Assumptions regarding collection of project data, reasonableness of results, and the appraisal of the damages prevented are consistent with existing Corps criteria and policy. All appropriate ITR comments have been incorporated into this product. Accordingly, the undersigned recommends certification of the quality control process for this product.

Janice Lera Chan — 4-8-08

Janice Lera-Chan — Date
Chief, Water Resources Section

Herb Cheong — 4/8/08

Herbert H. Cheong, P.E. — Date
Chief, Engineering Branch

QUALITY CONTROL CERTIFICATION

As noted above, all issues and concerns associated with the development and independent technical review of the product have been resolved. All quality control requirements for this product have been completed.

C. Wang — 3/31/08

Jim Wang, P.E. — Date

*This ITR does not include the San Francisquito Creek portion of the report, since it is currently undergoing an independent ITR as part of the San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Feasibility Study.

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Engineering Unit Manager

PROJECT TITLE: South San Francisco Bay Shoreline Study
LOCATION: Matadero, Baron, Adobe, Stevens and Permanente Creeks, Santa Clara County, CA

GENERAL FINDINGS: I certify that the quality control process has been completed. All technical issues regarding the SCVWD West Valley Watershed Hydrology Report have been identified and resolved.

3/18/08
Date

Terry L. Marks
Hydraulic Engineer, SPN

3/18/08
Date

Janice Lera Chan
Janice Lera-Chan
Chief, Water Resources Section, SPN

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Independent Technical Review

GENERAL NOTE ON COMMENTS:

Responses to specific comments are shown in BOLD font below each comment.

COMMENTS:

1. There are a few drainage areas/watershed boundaries on the Joint Powers Authority & Oakland Museum map appear different than those shown in your report. Please verify that your watershed is based on the most current information. The major areas in question are as follows:

   a. Matadero Ck comparing the SCVWD drainage Basin V, with the drainage basins defined by the Palo Alto and E. Palo Alto Joint Powers Authority and the Oakland Museum maps, the SCVWD Basin V is defined differently. Similar comment submitted as part of the San Francisquito Ck Hydrology ITR.

   b. Permanente Ck comparing the SCVWD drainage basin J, with the drainage basins defined by the Palo Alto and E. Palo Alto Joint Powers Authority and the Oakland Museum maps, the SCVWD Basin J is defined differently particularly near Hwy 280.

   Response: **We concur with the comments.** After checking on Matadero, Permanente and Stevens Creek Watershed Maps, several differences in drainage basins were noted. However, the SCVWD's watershed boundaries are delineated not solely based on the city's storm drainage systems. In general, sub-basins are delineated following the ground surface contours as the 1% flood flow in excess of storm drain capacities would travel following the lay of the land which may not be in the same direction of the storm sewers.

   Backcheck: Comment closed.

2. Section 2.1, Design Storm Precipitation - Include the MAP results and a discussion in how they compared with the nearby rainfall gage station in validating the results?

   Response: **Noted.** The precipitation regional equation results will be included in the parameter table in the Appendix along with weighted rainfalls from nearby gages.

   Backcheck: Comment closed.

3. Section 2.2, Flood Flow Regression Model – The report includes a discussion on the regression model, however it does not discuss the use in the final results included in the appendices. Please include a comparison & discussion of the Flood Flow regression Model results and the HEC-1 results were reported in this report.

   Response: **Noted.** Discussions will be included in the updated report.

   Backcheck: Comment closed.

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*This ITR does not include the San Francisquito Creek portion of the report, since it is currently undergoing an independent ITR as part of the San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Feasibility Study.

4. Section 2.6, Routing procedures
   a. Indicate what kind of routing was used for the rural areas as well.
   b. Puls is spelled wrong, 3rd sentence.

Response: Noted. Muskingum-Cunge routing method was used for channel routings. This will be included in the updated report along with corrected spelling.

Backcheck: Comment closed.

5. Section 3, Design Hydrograph Estimation for Rural and Urban Watersheds - The peak flow rates included in the report are for current land use conditions. (Based on various information from 1999 – 2001.) How does the SCVWD plan on accounting for the effect of future land use condition on the peak flow rates? Please include discussion in report.

Response: Noted. Discussions will be included in the updated report.

Backcheck: Comment closed.

6. Section 5, Adobe Ck, Barron Ck and Matadero Ck Hydrology
   a. Include a discussion on the design flow results presented in Appendix A.
   b. What are the rainfall depths used? Please include in the report.
   c. Include a discussion on the AMC conditions used for the 10-yr and 100-yr models.
   d. The routing parameters used in the model are not discussed/presented, please include.
   e. Include a general discussion of the results presented in Appendix A. How do they compare with other studies?

Response: Noted. The above discussions will be included in the updated report.

Backcheck: Comment closed.

7. Section 6, Stevens Ck and Permanente Ck Hydrology
   a. Include a discussion on the design flow results presented in Appendix B.
   b. What are the rainfall depths used? Please include in the report.
   c. Include a discussion on the AMC conditions were used for the 10-yr and 100-yr models.
   d. The routing parameters used in the model are not discussed/presented, please include.
   e. Include a general discussion of the results presented in Appendix B. How do they compare with other studies?

Response: Noted. The above discussions will be included in the updated report.

Backcheck: Comment closed.

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Independent Technical Review

8. Appendix B, Page B-2 Comparison between SCVWD 1% and Schaaf & Wheeler 1% - Please include a discussion as to why there are differences. Also, 1st bullet item indicated there are differences in drainage areas, please explain.

   Response: Noted. The discussions will be included in the updated report.

   Backcheck: Comment closed.

9. For clarification purposes, since San Francisquito Creek is undergoing an independent ITR, the Lower Peninsula report be divided into two volumes, one for San Francisquito Creek and the other for the Creeks included in this ITR.

   Response: Noted. SCVWD will submit an updated report without the inclusion of San Francisquito Creek.

   Backcheck: Comment closed.

10. General Comment on Appendices – All of the maps in the appendices are difficult to read, due to scale. Additionally, there are no land marks noted, such as major streets, catch points, ect.

    Response: Noted. The updated report in PDF file format will enable readers to print/plot revised maps with landmarks in large sizes.

    Backcheck: Comment closed.

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*This ITR does not include the San Francisquito Creek portion of the report, since it is currently undergoing an independent ITR as part of the San Francisquito Creek Flood Damage Reduction and Ecosystem Restoration Feasibility Study.

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SANTA CLARA VALLEY WATER DISTRICT

LOWER PENINSULA WATERSHED HYDROLOGY REPORT

For San Francisquito Shoreline Project

Prepared by

James Wang, PhD, PE
Engineering Unit Manager

Wendy Chang, PE
Associate Civil Engineer

Nahm Lee
Assistant Engineer

July, 2004

Revised December, 2007

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SANTA CLARA VALLEY WATER DISTRICT

LOWER PENINUSULA WATERSHED HYDROLOGY REPORT

1. INTRODUCTION

This report summarizes the work completed on the hydrology within the Santa Clara Valley Water District's Lower Peninsula Watershed. Presented in the report are recommended design flows for Matadero, Barron, Adobe, Stevens, Permanente Creeks and each of their respective tributaries. This report is tailored for the San Francisquito Shoreline Project and a separated hydrology report is prepared for the San Francisquito Creek.

The following is a list of the tributaries analyzed in this study:

Matadero-Barron-Adobe Creeks and Palo Alto Flood Basin Hydrology
- Adobe Creek
- Barron Creek
- Deer Creek
- Matadero Creek
- Palo Alto Flood Basin

Stevens and Permanente Creeks Hydrology
- Hale Creek
- Permanente Creek
- Permanente Diversion
- Stevens Creek

2. HYDROLOGIC MODEL

This section provides a summary of the method and procedures developed and used for the hydrology study. Refer to the District's publication entitled "Hydrology Procedures (Saah et al, 2006)" for more detailed information.

2.1 Design Storm Precipitation

The design storm precipitation is obtained by using the weighted rainfall gage stations data which is checked against the District's Precipitation Global Regional Equations (Saah et al, 1996). The design storm precipitation is then applied to an appropriate rainfall-runoff model for estimating the flood runoff.

The followings describes how the precipitation depth is obtained from the Global Regional Equations:

From the isohyetal map of mean annual precipitation (MAP), locate the specific location of the site and determine the MAP. Some interpolation may be required to obtain the MAP.

Given the mean annual precipitation for the ungaged site, the precipitation intensity is calculated as:

$$i_{T,D} = \frac{a_1 T^{a_2} \exp[SD_e{}^2 / 2]}{D^{a_3}} \qquad \textbf{(1)}$$

Where:

$i_{T,D}$ = the predicted precipitation intensity in inches per hour or inches per day at return period T
T = return period in years as the recurrence intervals
D = duration D in hours or days
$[a_1, a_2, a_3]$ = model coefficients
SD_e = the standard deviation of the model residuals (random term).

The precipitation depth (in inches) $x_{T,D}$ can be obtained from the precipitation intensity $i_{T,D}$ by the following relation:

$$x_{T,D} = i_{T,D}.D \qquad (2)$$

For short duration rainfall of a 1% event (specifically for durations of 5 minutes, 10 minutes, up to as much as 24 hours), the model parameters $[a_1, a_2, a_3]$ and SD_e are as follows:

$$\begin{aligned} a_1 &= 0.2675 + 0.01199 \cdot MAP + 0.00002472 \cdot E \\ a_2 &= 0.167033 \\ a_3 &= 0.5853 - 0.004155 \cdot MAP - 0.000001096 \cdot E \end{aligned} \qquad (3)$$

SD_e =0.120039 for short duration data

Where:

MAP = the mean annual precipitation in inches
E = the elevation of the ungaged site in feet.

Note that D for short duration rainfall analysis in Eq. (1) is in hours.

To illustrate the use of Eq. (1), the example of estimating the 24-hour, 100-year return period storm rainfall at the sub basin H2 in the Stevens Creek watershed is used.
Given parameters are

$$\begin{aligned} T &= 100\text{-year} \\ D &= 24\text{-hour} \\ SD_e &= 0.120039 \end{aligned} \qquad (4)$$

And basin characteristics of sub basin H2 are

$$\begin{aligned} E &= 1123 \text{ feet} \\ MAP &= 33.36 \text{ inches} \end{aligned} \qquad (5)$$

Substitute basin characteristics (5) into Eq. (3) then the coefficients are

$$a_1 = 0.2675 + 0.01199 \times 33.36 + 0.00002472 \times 1123 = 0.695247$$
$$a_2 = 0.167033$$
$$a_3 = 0.5853 - 0.004155 \times 33.36 - 0.000001096 \times 1123 = 0.445458$$

substitue the numerical parameters (4) and the coefficients into Eq. (1), then

$$i_{T,D} = \frac{0.695247 \times 100^{0.167033} \exp[0.120039^2 / 2]}{24^{0.445458}} = 0.366866 \quad inches\ per\ hour$$

Apply Eq.(2) with this precipitaion intensity value, the precipitation depth of the 100-year, 24-hour storm rainfall for sub basin H2 is therefore 8.80 inches as shown below.

$$x_{T,D} = 0.366866 \times 24 = 8.80 \;\; inches$$

For sub basin H2, the weighted rainfall gage stations depth is 9.1 inches which is close to the precipitation depth obtained from the Global equations. Refer to section 4 for further discussions of rainfalls.

2.2 Flood Flow Regression Model

Since the early 1970s, the District has utilized regional regression and correlation techniques to estimate design flows at ungaged locations. The regional regression equations are formulas consisting of flow information such as values from gaged stations as dependent variables and measurable watershed characteristics as independent variables. The application of these equations on ungaged locations will result in estimates of flood flow from any watershed for 1% or 10% design flows. Regional regression equations usually apply to rural watersheds, and they are generally used for an initial flow rate range check.

The District updated the regional regression equations in 2003 to include data through 2000 based on historical data from Santa Clara County and Santa Cruz County. The outcomes of this study are documented in a report entitled *Development of Regional Regression Equations to Calculate Flood Quantiles in Santa Clara County* (Saah et al, 2003). The updated regional regression equations to estimate 24-hr peaks and 1-day volumes for both the 1% and 10% quantiles are as shown below:

FOR 24-hr PEAKS in cfs:

$$Q_{1\%} = 11.22 \times A^{0.954} \times MAP^{1.03}$$
$$Q_{10\%} = 2.985 \times A^{0.988} \times MAP^{1.173}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

FOR 1-day VOLUMES in cfs/day:

$$V_{1\%} = 2.254 \times A^{0.964} \times MAP^{1.187}$$

$$V_{10\%} = 0.895 \times A^{0.933} \times MAP^{1.244}$$

Where:

A = the watershed area in square miles
MAP = the mean annual precipitation in inches

Note: The 24-hr volume may be approximated by multiplying the 1-day volume by a factor of 1.15.

2.3 Loss Rates

The loss rates for the rural and pervious parts of sub-watersheds are calculated using the Soil Conservation Service (SCS) Curve Number (CN) method. For all impervious areas, loss rates are assumed to be minimal. The hydrologic soil type, the Antecedent Moisture Content (AMC) and the ground cover are defined for each sub-watershed and are used to determine the respective Initial Abstraction (Ia) and the CN values.

The Antecedent Moisture Conditions are further calibrated for various watershed conditions and various frequencies of occurrences using the flood volumes obtained from the regression equations as well as the rainfall-runoff model. Based on this information, the Ia and CN values for the updated AMC are calculated and input into the HEC-1 model. A map of hydrologic soil types for each watershed is included in the appendices.

2.4 Clark's Synthetic Hydrograph Parameters (Tc and R)

The unit hydrograph parameters applicable to this study are calculated and presented for each creek. Rural, pervious and impervious parts of each sub-watershed are considered separately. The Time of Concentration (Tc) is calculated using Kirby Hathaway's formula:

$$Tc = 0.01377[(L * n)^{0.47} S^{-0.235}]$$

Where:

L=distance of overland flow in feet (ft)
n=Manning's watershed roughness coefficient
S=average slope in ft/ft

The Routing Coefficient (R) is calculated based on an acceptable routing indicator: R/(Tc+R). This indicator directly impacts the peaking characteristics of hydrographs. For rural and pervious sub-sub-watersheds, the indicator is ranging between 0.5 and 0.9 based on the calibration process with regression quantiles. For impervious sub-sub watersheds, the indicator is generally ranging between 0.1 and 0.5.

2.5 Urban Hydrology

In 1996, an urban hydrology procedure (Wang and Saah 1996) was developed which addressed the impact of urban growth on flood flows. This procedure accounts for the effects on runoff due to two major urban changes: increased imperviousness and increased channelization. Increased imperviousness reduces the overland flow travel time and thus increases the volume of flow.

Increased channelization addresses the impact of conveyance through gutters and storm drains together with the increased storage capability of these facilities. Imperviousness represents coverage from streets, buildings and other lot coverage. The coverage from streets in urban residential areas ranges from 2% to 25%, while for other land uses the value can be as high as 95% of the total lot area. The concept of "Equivalent Street" is obtained from the land use requirements for ratio of streets as a part of the total urban sub-watershed. Based on this equivalent street concept, the length and width of streets in an urbanized area are defined and, hence, the unit hydrograph parameters are calculated. The following are the formulas used in this study to calculate unit hydrograph parameters as input to HEC-1.

The following describes how equivalent street length and time of concentration are obtained in urban areas:

Equivalent street length (all measurements are in ft or square ft) is calculated by the equation:

$$L_{st}=A_{st}/W_{st}$$

Where:

L_{st} = the equivalent street length
A_{st} = area of streets, (from land use guidelines)
W_{st} = width of streets (from traffic guidelines)

Overland flow length is calculated by the equations:

$$L_i = (A_i - A_{st})/2L_{st}$$
$$L_p = A_p /2L_{st}$$

Where:

L_i = length of overland flow of impervious area
A_i = impervious area, (from land use guidelines)
L_p = length of overland flow of pervious area
A_p = pervious area

The impervious length of overland flow is given by the equation $L_{imp} = L_i + L_{Cb}$ where L_{Cb} is the length of flow to the first catch basin (normally less than 300 ft), and L_i is defined above. The pervious length is given by the equation $L_{perv} = L_p + L_{imp}$.

The Time of Concentration (Tc) is calculated separately for pervious and impervious areas using Kirby-Hathaway's formula as defined in Section 2.4. Time of Concentration for impervious areas is calculated as:

$$Tc_{imp} = Tc_i + Tc_{cb}$$

Where:

Tc_{imp} = Time of Concentration for the impervious area
Tc_i = Time of Concentration of overland flow over impervious area
Tc_{cb} = Time of Concentration of flow length to first catch basin

Time of concentration for pervious areas is calculated as:

$$Tc_{perv} = Tc_{p} + Tc_{imp}$$

Where:

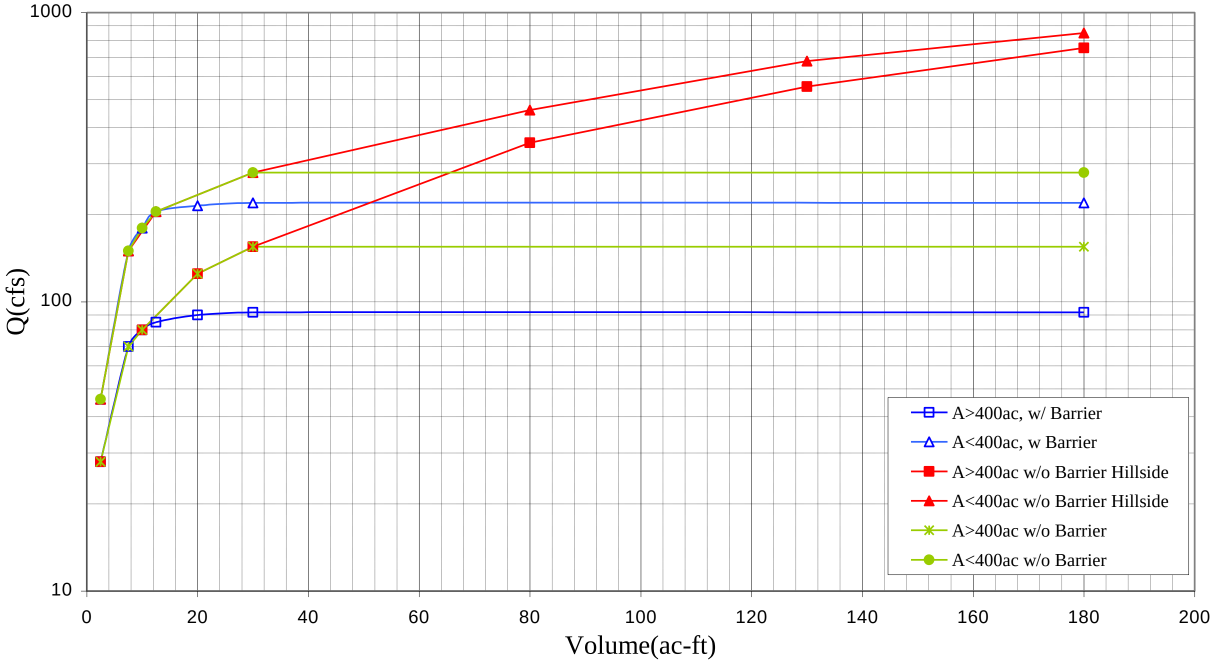
Tc_{perv} = Time of Concentration for pervious area
Tc_{p} = Time of Concentration of overland flow over pervious area
Tc_{imp} = Time of Concentration of the impervious length of overland flow

2.6 Routing Procedures

Most of the flood waters from urban areas are conveyed to flood control channels via storm drain systems. Storage-discharge rating curves based on Santa Clara Valley's storm drain system for average condition are presented in Figure 1. It shows the general unitized (prorated to one square mile of an area) storage-discharge rating curves that may be applied to valley urban areas. However, to minimize the impact from diversified design frequencies and/or criteria for the existing storm drain system, it is recommended that more detailed analysis of the storm drain storage-discharge relationship be performed for the specific project if a higher degree of accuracy is desired. The combined pervious and impervious inflow hydrographs for a study area are routed through the storm drains using the modified puls routing method. The storage-discharge relationship for that area is calculated from a unitized relationship and applied to obtain the outflow from the storm drain system. The storage routing usually consists of two types of boundary conditions: namely, "with barrier" (eg. berms, levees, houses and etc.) and "without barrier" conditions. The "with barrier" conditions can be found in the lower parts of a watershed, where the lay of the land has flat or mild slopes (generally less than 0.02). Here, the urban runoff can only reach the creeks through the storm drain system, without the possibility of overland connections. The "without barrier" condition generally exists at the upper part of a watershed where slopes are steep (generally greater than 0.02), or in areas without flood control improvements. Runoff water from these areas without barriers normally finds its overland course and eventually reaches the creek channels.

For channel routing, Muskingum-Cunge Routing method was used. Refer to Appendices for the channel routing parameters applied.

Figure 1. General Unitized Storage-Discharge Rating Curve (prorated to one square mile of an area)



3. DESIGN HYDROGRAPH ESTIMATION FOR RURAL AND URBAN WATERSHEDS

The hydrologic modeling tool adopted for this study is the HEC-1 Flood Hydrograph Package developed by the U.S. Army Corps of Engineers (1990).

The HEC-1 model has several optional procedures to simulate the various components of the rainfall-runoff process in a watershed. Based on previous modeling studies of rural and urban watersheds around the Santa Clara Valley, the approach adopted by the District in the use of the HEC-1 model for rainfall-runoff modeling is summarized as follows:

- The land use is based on the generalized land use information from Association of Bay Area Governments (ABAG 1999), Santa Clara County Parcel Data (2001), and Santa Clara County Ortho Photos (2001).
- The SCS curve number is calculated based on Hydrologic Soil Groups from Soil Survey of San Mateo County by United States Department of Agriculture, Natural Resources Conservation Service (1998) and Santa Clara County published by the United States Department of Agriculture, Soil Conservation Service.
- The longest flow path is defined as a sum of the main channel length and overland flow length. The slope for the basin is calculated using the elevation difference divided by the longest length.
- A watershed boundary is delineated using the 7.5-minute Digital Elevation Model available from USGS. For rural areas, the boundary follows the contour lines. For urban areas, the boundary follows the street, storm drain system and the contour.
- *SCVWD Maps of Flood Control Facilities and Limits of 1% Flooding* is utilized for geometric elements of the channel sections.

The District does not anticipated major land use change in Lower Peninsula watersheds for the next ten years, since they are mostly urban and fully developed.

4. ADOBE CREEK, BARRON CREEK AND MATADERO CREEK HYDROLOGY

Matadero, Barron and Adobe Creeks are tributaries to the Palo Alto Flood Basin. The total drainage area of these three creeks is approximately 28 square miles. Nearly half of the watershed area is on the valley floor and has undergone extensive urbanization. The watershed receives an average annual rainfall ranging from 14.5 inches in the flood basin to 37 inches in the uppermost reaches of Adobe Creek where the elevation is over 2,600 feet.

There are many precipitation stations that collectively represent the precipitation patterns on the watershed. These stations are listed below with the 24 -hour, 1% and 10% rainfall depth totals.

Gage Station Number	Gage Station Name	24 hrs 1% Rainfall Depth (inches)	24 hrs 10% Rainfall Depth (inches)
24	Dahl Ranch, S.C.V.W.D. Recording	6.42	4.72
53	Maryknoll, S.C.V.W.D. Recording	4.40	3.24
77	Valley Christian, S.C.V.W.D. Recording	8.97	7.01
121	Mtn. View Corp. Yard, S.C.V.W.D. Recording	3.44	2.39
129	Palo alto Reclamation Plant, S.C.V.W.D. Recording	3.36	2.44

The weighted rainfalls from the surrounding precipitation stations were applied to the rainfall-runoff model. These rainfalls were closely in comparisons with the estimates obtained from the global equations. The rainfall input range for 24-hr duration varies from 9.1 inches (1%) and 7.1 inches (10%) for sub-basin B to 4.2 inches (1%) and 3.1 inches (10%) for sub-basin K. These values are very close to the weighted rainfall amounts calculated from the rain gages.

Appendix A contains tables and figures that represent the hydrologic characteristics and design flows for Matadero, Barron and Adobe Creeks.

5. STEVENS CREEK AND PERMANENTE CREEK HYDROLOGY

The Stevens Creek watershed lies on the northeastern slopes of the Santa Cruz Mountains in Santa Clara County between Permanente Creek and Calabazas Creek. Stevens Creek runs easterly from its headwaters to Stevens Creek Reservoir. The reservoir was constructed in 1934. In 1985, an additional 231,000 cubic yards of material was added to the dam, and raised it by 10 feet. The reservoir capacity is approximately 3,100 acre-feet of water with its surface area close to 90 acres.

Downstream of the reservoir, the creek runs northerly through Sunnyvale and Mountain View. It discharges into South San Francisco Bay through Whisman Slough just to the east of Permanente Creek. The total drainage area of the watershed upstream of Highway 101 is 46 square miles.

In addition to various concrete culverts and channel modifications, the flow in the creek is affected by the presence of Stevens Creek Reservoir with 3,100 acre-feet capacity. In 1960, a flood control diversion structure was constructed to divert a portion of high flows from Upper Permanente Creek to Stevens Creek. Therefore, Permanente Creek upstream of the diversion is considered as a part of the Stevens Creek watershed, and the lower part of Permanente Creek watershed is analyzed separately.

The mean annual precipitation on the basin varies from a high of about 50 inches on the upper slopes of the Santa Cruz Mountains, to a low of about 13.5 inches on the valley floor near the Bay. The majority of this precipitation occurs in the rainy season between November and April. The watershed's elevation ranges from 2,300 feet at the upper watershed, down to near sea level at the bay. The upper elevations are characterized by moderately dense forests and steep slopes. The valley floor is marked by moderate to high urbanization and a gentle slope towards the Bay.

There are many precipitation stations that collectively represent the precipitation patterns on the watershed. These stations are listed below with the 24 -hour, 1% and 10% rainfall depth totals.

Gage Station Number	Gage Station Name	24 hrs 1% Rainfall Depth (inches)	24 hrs 10% Rainfall Depth (inches)
21	Los Gatos Summit, Santa Cruz County	11.25	7.98
24	Dahl Ranch, S.C.V.W.D. Recording	6.42	4.72
53	Maryknoll, S.C.V.W.D. Recording	4.40	3.24
77	Valley Christian, S.C.V.W.D. Recording	8.97	7.01
100	Stevens Creek, S.C.V.W.D. Recording	6.56	5.00
121	Mtn. View Corp. Yard, S.C.V.W.D. Recording	3.44	2.39

The weighted rainfalls from the surrounding precipitation stations were applied to the rainfall-runoff model. These rainfalls were closely in comparisons with the estimates obtained from the global equations. The rainfall input range for 24-hr duration varies from 11.3 inches (1%) and 8.0 inches (10%) for sub-basin H1 to 4.2 inches (1%) and 3.1 inches (10%) for sub-basin N. The results are listed in Appendix A-8 through A-11.

Appendix A contains tables and figures that represent the hydrologic characteristics and design flows for Stevens and Permanente Creeks.

REFERENCES

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APPENDIX A

ADOBE CREEK, BARRON CREEK AND MATADERO CREEK HYDROLOGY INFORMATION

The following Table shows the design flows for Adobe Creek, Matadero Creek and Barron Creek at various catch points using the procedures as presented in this report:

Design Flows for Adobe, Matadero and Barron Creek

Location	Drainage Area mi^2	PEAK FLOW (cfs)					
		2.33 year(*) Q 43%	5 year(*) Q 20%	10 year Q 10%	25 year(*) Q 4%	50 year(*) Q 2%	100 year Q 1%
Adobe Creek @ City Limits (A2)	**4.30**	**370**	**660**	**920**	**1,300**	**1,500**	**1,800**
Adobe Creek @ Foothill Expressway (A4)	**7.13**	**500**	**920**	**1,300**	**1,800**	**2,200**	**2,600**
Adobe Creek @ El Camino Real (A5)	**9.00**	**680**	**1,200**	**1,600**	**2,200**	**2,600**	**3,000**
Adobe Creek u/s Barron Creek (A7)	**11.06**	**750**	**1,300**	**1,700**	**2,300**	**2,700**	**3,100**
Barron Creek @ Foothill Expressway (B1)	**1.71**	**220**	**340**	**440**	**560**	**640**	**720**
Barron Creek d/s Sediment Basin (B2)	**1.71**	**200**	**300**	**400**	**520**	**600**	**700**
Barron Creek Diversion to Metadero Creek		**100**	**200**	**250**	**350**	**400**	**500**
Barron Creek d/s Diversion (B3)	**1.71**	**100**	**100**	**150**	**170**	**200**	**200**
Barron Creek @ El Camino Real (B4)	**2.48**	**210**	**220**	**220**	**220**	**230**	**230**
Barron Creek @ US 101 (B5)	**3.04**	**280**	**310**	**320**	**330**	**340**	**350**
Adobe-Barron Creek @ US 101 (AB)	**14.10**	**970**	**1,500**	**2,000**	**2,600**	**3,000**	**3,400**
Matadero Creek u/s Deer Creek(M2)	**3.88**	**260**	**460**	**630**	**860**	**1,000**	**1,200**
Deer Creek u/s Matadero Creek (D)	**1.67**	**100**	**170**	**240**	**330**	**390**	**460**
Matadero Creek d/s Deer Creek (M3)	**5.55**	**350**	**620**	**870**	**1,200**	**1,500**	**1,700**
Matadero Creek u/s Bypass (M4)	**6.02**	**400**	**700**	**960**	**1,300**	**1,550**	**1,800**
MataderoCreek Bypass		**300**	**400**	**550**	**700**	**800**	**900**
Matadero Creek d/s Bypass (M5)	**6.02**	**100**	**300**	**410**	**600**	**750**	**900**
Barron Diversion & Metadero Bypass		**400**	**600**	**800**	**1,050**	**1,200**	**1,400**
Matadero Creek @ El Camino Real (USGS 11166000) (M8)	**8.28**	**670**	**1,100**	**1,500**	**2,000**	**2,400**	**2,700**
Matadero Creek @ Alma St (M9)	**10.45**	**860**	**1,300**	**1,700**	**2,200**	**2,500**	**2,800**
Matadero Creek @ US 101 (M10)	**12.52**	**1,000**	**1,500**	**1,900**	**2,400**	**2,700**	**3,000**

(*) extrapolated and interpolated by using log Pearson Type III distribution

The following Table shows the comparison between the 100-year flow rates presented in this report and 1999 Schaff and Wheeler's study. The flow rates are close in comparison.

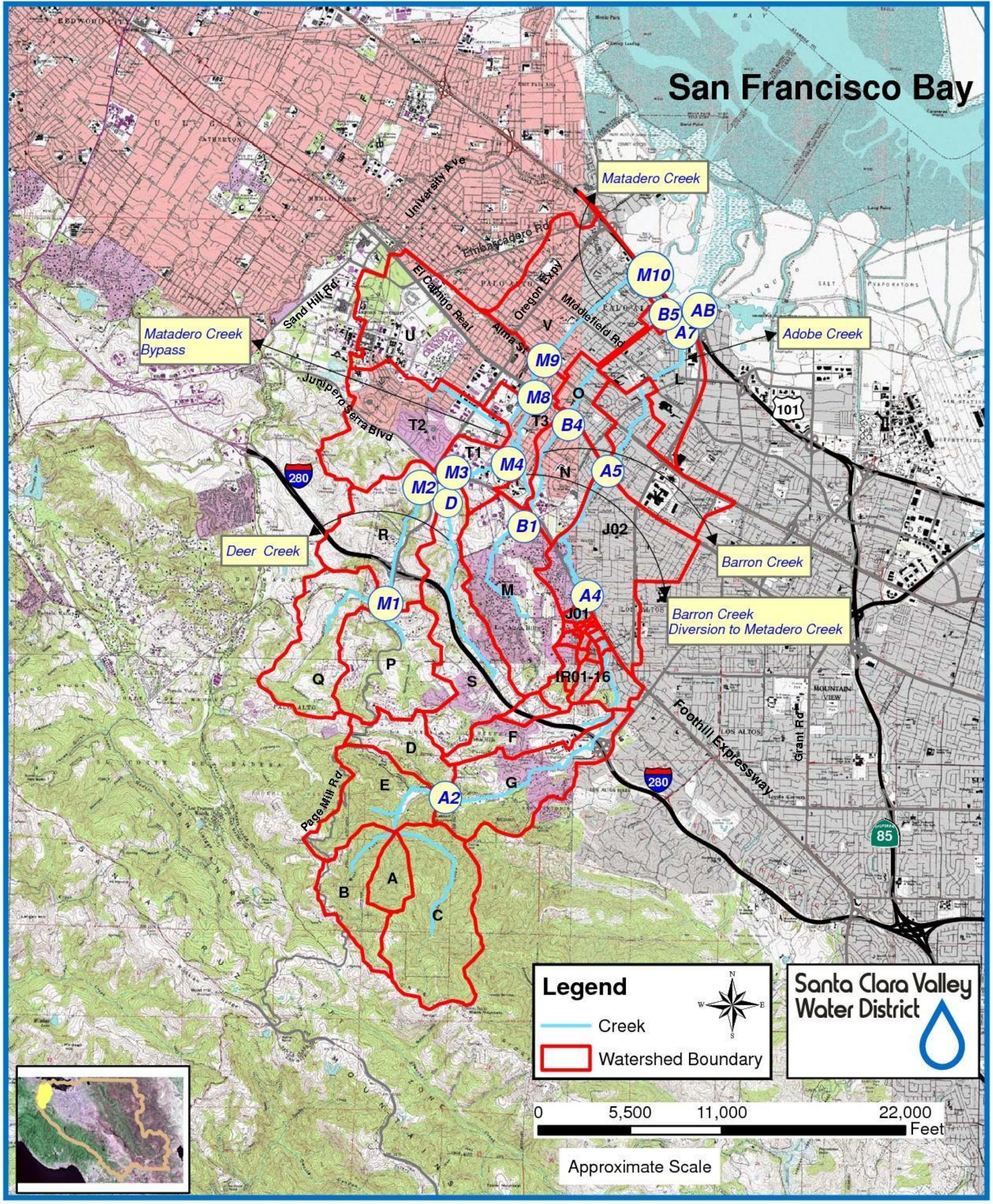
Design Flow Comparison

	PEAK FLOW (cfs)			
Location	Drainage Area	100 year	1999 Schaaf & Wheeler 100 Year (1)	Drainage Area
	mi^2	Q 1%	Q 1%	mi^2
Adobe Creek @ City Limits (A2)	4.30	1,800	1,620	2.71
Adobe Creek @ Foothill Expressway (A4)	7.13	2,600	2,720	7.53
Adobe Creek @ El Camino Real (A5)	9.00	3,000	----	----
Adobe Creek u/s Barron Creek (A7)	11.06	3,100	2,970	10.81
Barron Creek @ Foothill Expressway (B1)	1.71	720	740	1.8
Barron Creek d/s Sediment Basin (B2)	1.71	700	----	----
Barron Creek Diversion to Metadero Creek		500	----	----
Barron Creek d/s Diversion (B3)	1.71	200	----	----
Barron Creek @ El Camino Real (B4)	2.48	230	160	1.8
Barron Creek @ US 101 (B5)	3.04	350	250	2.87
Adobe-Barron Creek @ US 101 (AB)	14.10	3,400	3,250	13.97
Matadero Creek u/s Deer Creek(M2)	3.88	1,200	1,400	4.01
Deer Creek u/s Matadero Creek (D)	1.67	460	----	----
Matadero Creek d/s Deer Creek (M3)	5.55	1,700	1,900	5.61
Matadero Creek u/s Bypass (M4)	6.02	1,800	----	----
MataderoCreek Bypass		900	----	
Matadero Creek d/s Bypass (M5)	6.02	900	940	----
Barron Diversion & Metadero Bypass		1,400	----	----
Matadero Creek @ El Camino Real (USGS 11166000) (M8)	8.28	2,700	2,690	7.49
Matadero Creek @ Alma St (M9)	10.45	2,800	2,800	8.45
Matadero Creek @ US 101 (M10)	12.52	3,000	3,060	15.81

- ----: Not Available
- The highlighted flowrates are the design flows for the projects completed or underway recently.

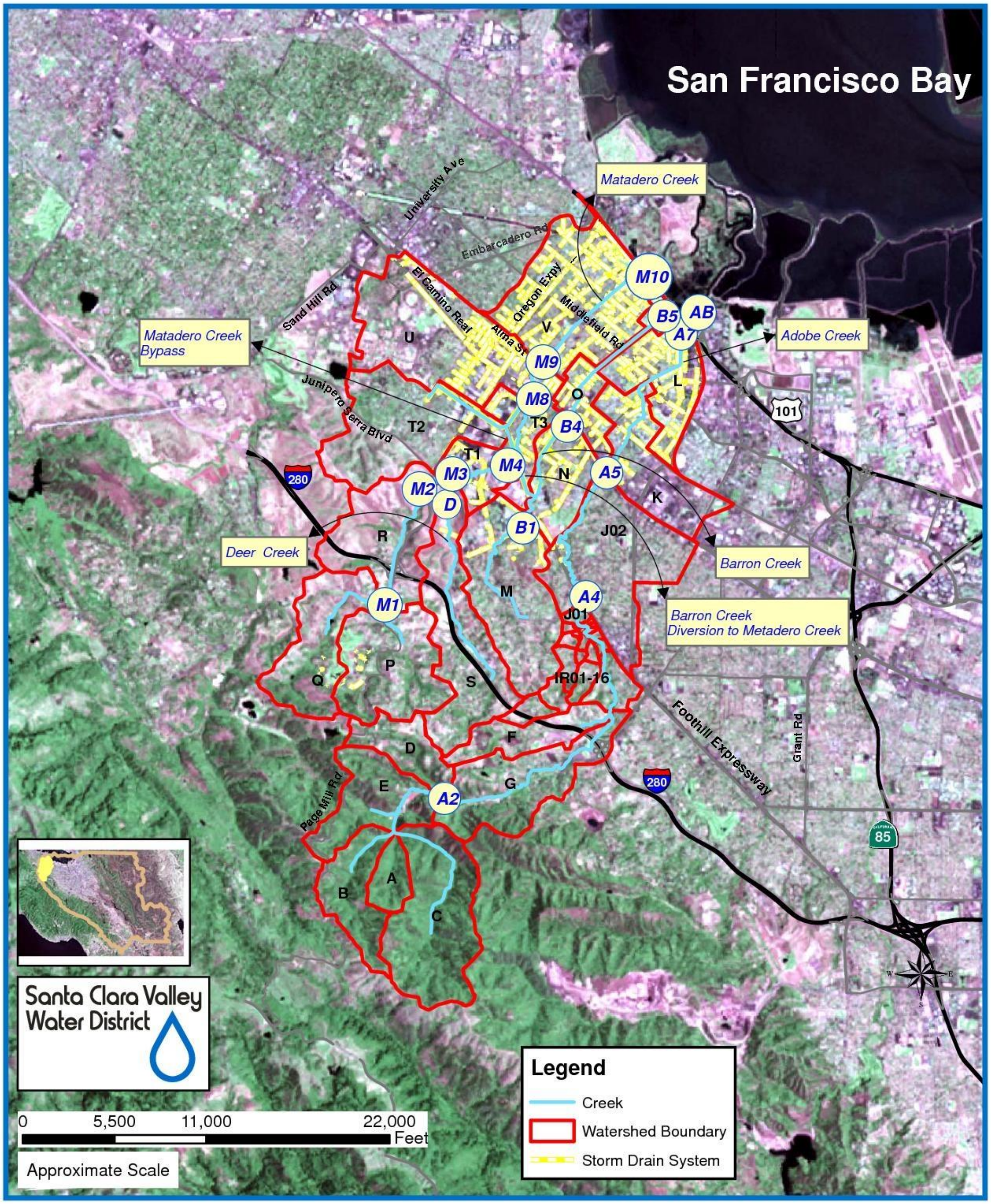
Watershed Boundary

Adobe,Barron and Metadero Creeks



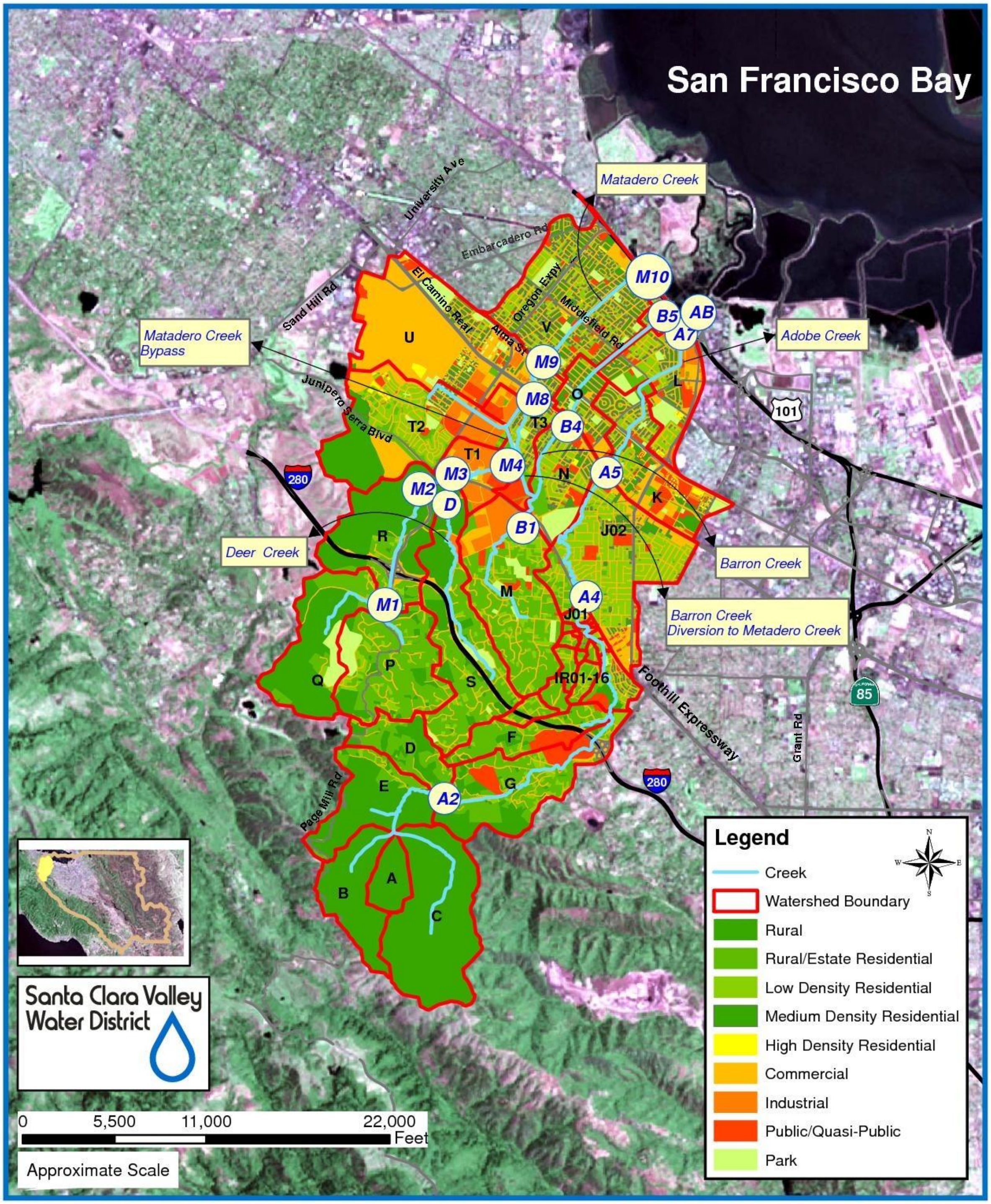
Storm Drain System

Adobe,Barron and Metadero Creeks



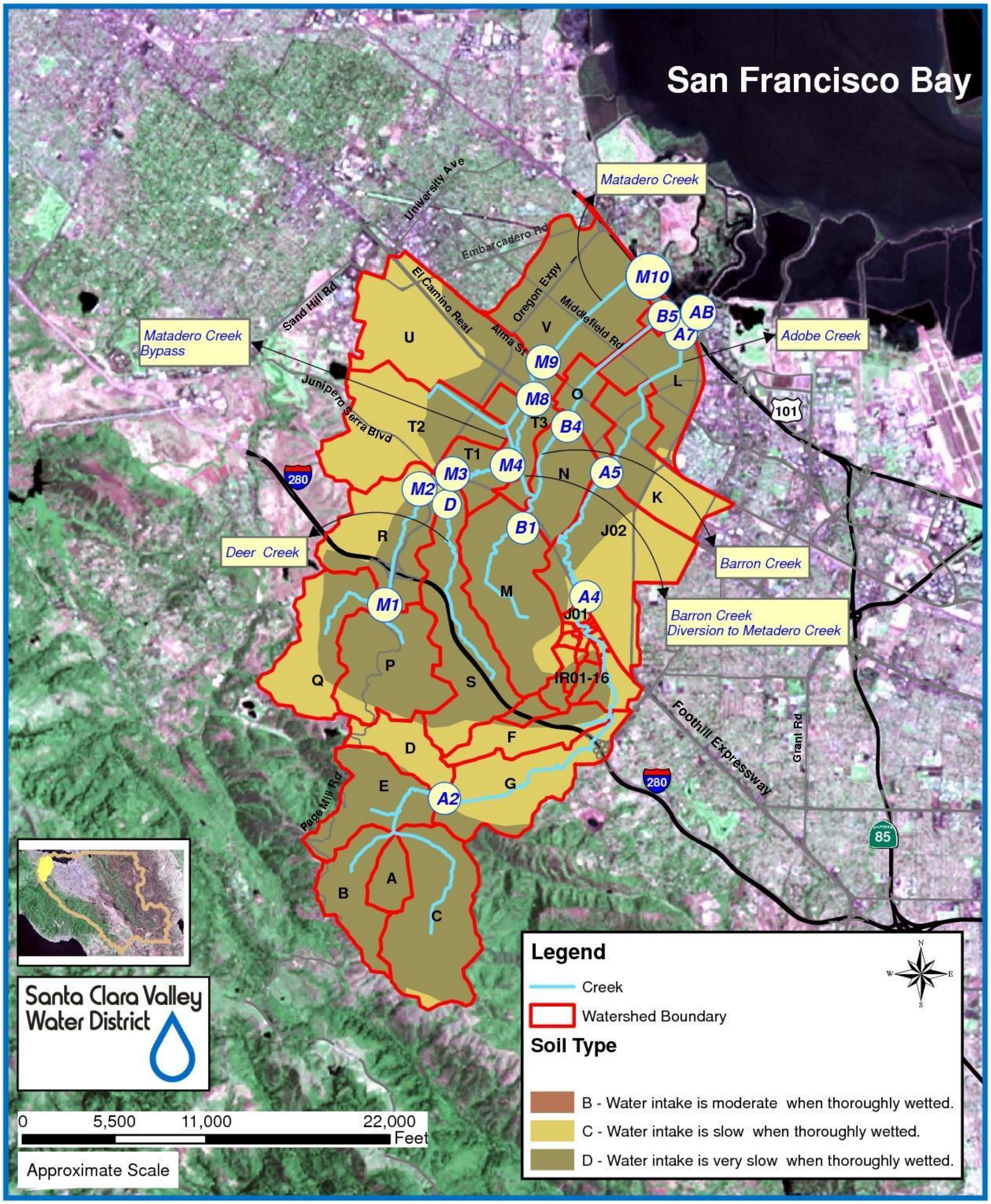
Land Use

Adobe,Barron and Metadero Creeks



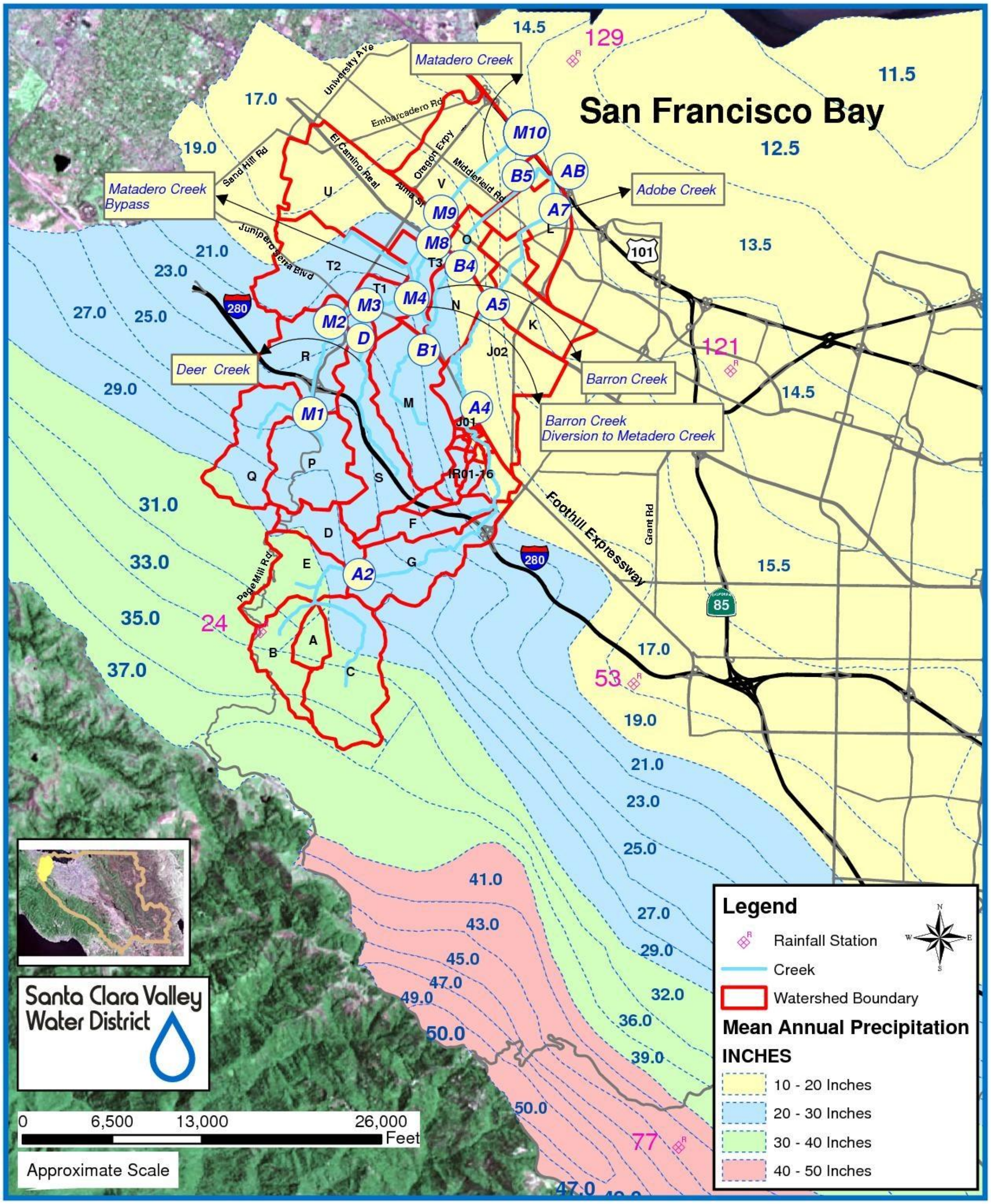
Soil Type

Adobe,Barron and Metadero Creeks



Mean Annual Precipitation

Adobe,Barron and Metadero Creeks



Adobe, Matadero and Barron Creek (1% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall Using Global Eq.	Weighted Rainfall Applied	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	0.305	0.305			0.48	81					0.29	0.87					8.64	8.61	2.25
B	0.769	0.769			0.48	81					0.49	1.48					9.14	9.10	2.25
C	1.699	1.699			0.59	77					0.56	1.30					8.97	9.10	2.25
D	0.558	0.238	0.240	0.080	0.68	75	0.42	83	0.04	98	0.50	1.17	0.45	1.06	0.21	0.14	7.45	7.89	2.25
E	0.968	0.795	0.121	0.052	0.48	81	0.32	86	0.04	98	0.50	1.17	0.42	0.99	0.21	0.14	8.10	7.89	2.25
F	0.602	0.074	0.290	0.237	0.65	75	0.40	84	0.04	98	0.30	0.71	0.41	0.96	0.22	0.15	6.27	6.67	2.25
G	1.323	0.349	0.536	0.438	0.59	77	0.42	83	0.04	98	0.31	0.93	0.39	1.18	0.22	0.15	6.70	6.67	2.25
IR01	0.253	0.046	0.093	0.114	0.59	77	0.37	84	0.04	98	0.46	1.38	0.41	1.23	0.23	0.15	5.31	5.42	2.25
IR02	0.022		0.012	0.010			0.42	83	0.04	98			0.51	1.52	0.24	0.16	5.22	5.42	2.25
IR03	0.017		0.009	0.009			0.42	83	0.04	98			0.44	1.31	0.23	0.15	5.22	5.42	2.25
IR04	0.009		0.005	0.005			0.42	83	0.04	98			0.44	1.33	0.23	0.15	5.22	5.42	2.25
IR05	0.102		0.071	0.031			0.30	87	0.04	98			0.41	1.24	0.20	0.14	5.60	5.42	2.25
IR06	0.028		0.020	0.008			0.34	85	0.04	98			0.38	1.14	0.20	0.13	5.27	5.42	2.25
IR07	0.018		0.014	0.005			0.42	83	0.04	98			0.59	1.76	0.23	0.15	5.37	5.42	2.25
IR08	0.123		0.074	0.049			0.30	87	0.04	98			0.37	1.12	0.21	0.14	6.18	5.42	2.25
IR09	0.097		0.073	0.024			0.30	87	0.04	98			0.38	1.14	0.20	0.13	5.84	5.42	2.25
IR10	0.092		0.060	0.032			0.34	85	0.04	98			0.45	1.35	0.22	0.14	5.64	5.42	2.25
IR11	0.016		0.012	0.004			0.34	85	0.04	98			0.40	1.20	0.20	0.13	5.63	5.42	2.25
IR12	0.032		0.022	0.010			0.42	83	0.04	98			0.45	1.34	0.21	0.14	5.63	5.42	2.25
IR13	0.007		0.005	0.002			0.42	83	0.04	98			0.38	1.13	0.20	0.13	5.62	5.42	2.25
IR14	0.015		0.011	0.004			0.42	83	0.04	98			0.45	1.36	0.21	0.14	5.63	5.42	2.25

1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square mile
4. The impervious part of the sub-watershed, area in square miles
5. Initial Abstraction (Ia) for rural area
6. Curve Number(CN) for rural area
7. Initial Abstraction (Ia) for pervious area
8. Curve Number(CN) for pervious area
9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Adobe, Matadero and Barron Creek (1% HEC-1 Input Data -Continued)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall Using Global Eq.	Weighted Rainfall Applied	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
IR15	0.004		0.002	0.003			0.42	83	0.04	98			0.40	1.19	0.23	0.15	5.22	5.42	2.25
IR16	0.005	0.002	0.001	0.002	0.68	75	0.42	83	0.04	98	0.22	0.67	0.59	1.78	0.28	0.19	5.28	5.42	2.25
IR17	0.007		0.003	0.004			0.42	83	0.04	98			0.40	1.21	0.24	0.16	5.22	5.42	2.25
IR18	0.005		0.002	0.003			0.42	83	0.04	98			0.59	1.76	0.37	0.24	5.47	5.42	2.25
J01	0.056		0.034	0.022			0.42	83	0.04	98			0.48	0.72	0.29	0.20	5.41	5.19	2.25
J02	1.866		0.840	1.026			0.37	84	0.04	98			0.51	0.76	0.33	0.22	5.00	5.19	2.25
K	1.109		0.333	0.776			0.34	85	0.04	98			0.38	0.57	0.23	0.16	4.50	4.16	2.25
L	0.947		0.331	0.616			0.30	87	0.04	98			0.51	0.77	0.26	0.18	4.39	4.16	2.25
M	1.709		1.025	0.684			0.30	87	0.04	98			0.42	0.64	0.22	0.14	6.01	6.08	2.25
N	0.772		0.347	0.425			0.30	87	0.04	98			0.41	1.63	0.22	0.15	5.39	5.48	2.25
O	0.559		0.168	0.391			0.30	87	0.04	98			0.41	1.64	0.24	0.16	4.88	4.79	2.25
P	1.365	0.228	0.853	0.284	0.53	79	0.30	87	0.04	98	0.34	0.79	0.39	0.90	0.20	0.13	7.14	7.28	2.25
Q	1.158	0.779	0.284	0.095	0.45	82	0.21	90	0.04	98	0.67	1.00	0.49	0.73	0.22	0.15	7.12	7.03	2.25
R	1.361	0.928	0.195	0.238	0.59	77	0.32	86	0.04	98	0.63	1.17	0.43	0.80	0.24	0.16	6.28	6.67	2.25
S	1.667	0.524	0.686	0.457	0.50	80	0.32	86	0.04	98	0.81	1.51	0.39	0.73	0.21	0.14	6.63	6.67	2.25
T1	0.467		0.070	0.397			0.30	87	0.04	98			0.34	0.62	0.24	0.16	5.96	6.01	2.25
T2	1.717	0.417	0.455	0.845	0.68	75	0.37	84	0.04	98	0.50	0.75	0.36	0.68	0.23	0.15	5.58	5.68	2.25
T3	0.544		0.190	0.354			0.30	87	0.04	98			0.46	0.85	0.25	0.17	5.56	5.68	2.25
U	2.174		0.326	1.848			0.37	84	0.04	98			0.40	0.73	0.26	0.17	5.07	5.19	2.25
V	2.063		0.825	1.238			0.30	87	0.04	98			0.46	0.86	0.24	0.16	4.81	4.69	2.25

1. **Total area of the sub-watershed in square miles**
2. **The rural part of the sub-watershed, area in square miles**
3. **The pervious part of the sub-watershed, area in square mile**
4. **The impervious part of the sub-watershed, area in square miles**
5. **Initial Abstraction (Ia) for rural area**
6. **Curve Number(CN) for rural area**
7. **Initial Abstraction (Ia) for pervious area**
8. **Curve Number(CN) for pervious area**
9. **Initial Abstraction (Ia) for impervious area**
10. **Curve Number(CN) for impervious area**
11. **Times of Concentration(Tc) for rural area**
12. **Clark's Storage Routing Coefficient R for rural area**
13. **Times of Concentration(Tc) for pervious area**
14. **Clark's Storage Routing Coefficient R for pervious area**
15. **Times of Concentration(Tc) for impervious area**
16. **Clark's Storage Routing Coefficient R for impervious area**
17. **Rainfall using Global Equation in inches**
18. **Applied Weighted Rainfall in inches**
19. **Antecedent Moisture Condition**

Adobe, Matadero and Barron Creek (10% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall Using Global Eq.	Weighted Rainfall Applied	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A	0.305	0.305			1.14	64					0.29	0.87					5.88	6.39	1.25
B	0.769	0.769			1.14	64					0.49	1.48					6.22	7.05	1.25
C	1.699	1.699			1.38	59					0.56	1.30					6.11	7.05	1.25
D	0.558	0.238	0.240	0.080	1.60	56	1.03	66	0.04	98	0.50	1.17	0.45	1.06	0.21	0.14	5.07	5.95	1.25
E	0.968	0.795	0.121	0.052	1.14	64	0.82	71	0.04	98	0.50	1.17	0.42	0.99	0.21	0.14	5.51	5.95	1.25
F	0.602	0.074	0.290	0.237	1.53	57	0.99	67	0.04	98	0.30	0.71	0.41	0.96	0.22	0.15	4.27	4.85	1.25
G	1.323	0.349	0.536	0.438	1.38	59	1.03	66	0.04	98	0.31	0.93	0.39	1.18	0.22	0.15	4.56	4.85	1.25
IR01	0.253	0.046	0.093	0.114	1.38	59	0.93	68	0.04	98	0.46	1.38	0.41	1.23	0.23	0.15	3.61	3.98	1.25
IR02	0.022		0.012	0.010			1.03	66	0.04	98			0.51	1.52	0.24	0.16	3.56	3.98	1.25
IR03	0.017		0.009	0.009			1.03	66	0.04	98			0.44	1.31	0.23	0.15	3.55	3.98	1.25
IR04	0.009		0.005	0.005			1.03	66	0.04	98			0.44	1.33	0.23	0.15	3.55	3.98	1.25
IR05	0.102		0.071	0.031			0.77	72	0.04	98			0.41	1.24	0.20	0.14	3.81	3.98	1.25
IR06	0.028		0.020	0.008			0.87	70	0.04	98			0.38	1.14	0.20	0.13	3.58	3.98	1.25
IR07	0.018		0.014	0.005			1.03	66	0.04	98			0.59	1.76	0.23	0.15	3.66	3.98	1.25
IR08	0.123		0.074	0.049			0.77	72	0.04	98			0.37	1.12	0.21	0.14	4.21	3.98	1.25
IR09	0.097		0.073	0.024			0.77	72	0.04	98			0.38	1.14	0.20	0.13	3.97	3.98	1.25
IR10	0.092		0.060	0.032			0.87	70	0.04	98			0.45	1.35	0.22	0.14	3.84	3.98	1.25
IR11	0.016		0.012	0.004			0.87	70	0.04	98			0.40	1.20	0.20	0.13	3.83	3.98	1.25
IR12	0.032		0.022	0.010			1.03	66	0.04	98			0.45	1.34	0.21	0.14	3.83	3.98	1.25
IR13	0.007		0.005	0.002			1.03	66	0.04	98			0.38	1.13	0.20	0.13	3.83	3.98	1.25
IR14	0.015		0.011	0.004			1.03	66	0.04	98			0.45	1.36	0.21	0.14	3.83	3.98	1.25

1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square mile
4. The impervious part of the sub-watershed, area in square miles
5. Initial Abstraction (Ia) for rural area
6. Curve Number(CN) for rural area
7. Initial Abstraction (Ia) for pervious area
8. Curve Number(CN) for pervious area
9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Adobe, Matadero and Barron Creek (10% HEC-1 Input Data -Continued)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall Using Global Eq.	Weighted Rainfall Applied	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
IR15	0.004		0.002	0.003			1.03	66	0.04	98			0.40	1.19	0.23	0.15	3.55	3.98	1.25
IR16	0.005	0.002	0.001	0.002	1.60	56	1.03	66	0.04	98	0.22	0.67	0.59	1.78	0.28	0.19	3.59	3.98	1.25
IR17	0.007		0.003	0.004			1.03	66	0.04	98			0.40	1.21	0.24	0.16	3.55	3.98	1.25
IR18	0.005		0.002	0.003			1.03	66	0.04	98			0.59	1.76	0.37	0.24	3.72	3.98	1.25
J01	0.056		0.034	0.022			1.03	66	0.04	98			0.48	0.72	0.29	0.20	3.69	3.71	1.25
J02	1.866		0.840	1.026			0.93	68	0.04	98			0.51	0.76	0.33	0.22	3.41	3.71	1.25
K	1.109		0.333	0.776			0.87	70	0.04	98			0.38	0.57	0.23	0.16	3.07	3.1	1.25
L	0.947		0.331	0.616			0.77	72	0.04	98			0.51	0.77	0.26	0.18	2.99	3.1	1.25
M	1.709		1.025	0.684			0.77	72	0.04	98			0.42	0.64	0.22	0.14	4.09	4.39	1.25
N	0.772		0.347	0.425			0.77	72	0.04	98			0.41	1.63	0.22	0.15	3.67	3.93	1.25
O	0.559		0.168	0.391			0.77	72	0.04	98			0.41	1.64	0.24	0.16	3.32	3.51	1.25
P	1.365	0.228	0.853	0.284	1.25	62	0.77	72	0.04	98	0.34	0.79	0.39	0.90	0.20	0.13	4.86	5.4	1.25
Q	1.158	0.779	0.284	0.095	1.09	65	0.56	78	0.04	98	0.67	1.00	0.49	0.73	0.22	0.15	4.84	5.18	1.25
R	1.361	0.928	0.195	0.238	1.38	59	0.82	71	0.04	98	0.63	1.17	0.43	0.80	0.24	0.16	4.28	4.85	1.25
S	1.667	0.524	0.686	0.457	1.19	63	0.82	71	0.04	98	0.81	1.51	0.39	0.73	0.21	0.14	4.51	4.85	1.25
T1	0.467		0.070	0.397			0.77	72	0.04	98			0.34	0.62	0.24	0.16	4.05	4.38	1.25
T2	1.717	0.417	0.455	0.845	1.60	56	0.93	68	0.04	98	0.50	0.75	0.36	0.68	0.23	0.15	3.80	4.15	1.25
T3	0.544		0.190	0.354			0.77	72	0.04	98			0.46	0.85	0.25	0.17	3.78	4.15	1.25
U	2.174		0.326	1.848			0.93	68	0.04	98			0.40	0.73	0.26	0.17	3.45	3.79	1.25
V	2.063		0.825	1.238			0.77	72	0.04	98			0.46	0.86	0.24	0.16	3.28	4.15	1.25

1. Total area of the sub-watershed in square miles
2. The rural part of the sub-watershed, area in square miles
3. The pervious part of the sub-watershed, area in square mile
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6. Curve Number(CN) for rural area
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9. Initial Abstraction (Ia) for impervious area
10. Curve Number(CN) for impervious area
11. Times of Concentration(Tc) for rural area
12. Clark's Storage Routing Coefficient R for rural area
13. Times of Concentration(Tc) for pervious area
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15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Channel Routing Parameters

BASIN	Channel Length (ft)	Channel Slope	Manning's n	Channel Width (ft)	Channel Side Slope	Channel Shape	FROM	TO
A								
B								
C	**5261**	**0.02179**	**0.0500**	**10.0**	**1.0**	**TRAP**	**A1**	**A2**
D								
E	**13545**	**0.01955**	**0.0500**	**10.0**	**1.0**	**TRAP**	**A2**	**A3**
F								
G	**4689**	**0.00804**	**0.0500**	**10.0**	**1.0**	**TRAP**	**A3**	**A4**
IR01	**818**	**0.00209**	**0.0500**	**10.0**	**1.0**	**TRAP**	**IR01**	**IR02**
IR02								
IR03								
IR04								
IR05	**1532**	**0.00715**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR05**	**IR06**
IR06	**606**	**0.00158**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR06**	**IR07**
IR07	**504**	**0.00603**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR07**	**IR16**
IR08	**1599**	**0.01031**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR08**	**IR09**
IR09	**2383**	**0.03321**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR09**	**IR10**
IR10								
IR11	**269**	**0.03023**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR11**	**IR10**
IR11	**780**	**0.00530**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR11**	**IR12**
IR12	**900**	**0.02200**	**0.024**	**5.0**		**CIRC**	**IR12**	**IR18**
IR13								
IR14	**450**	**0.02200**	**0.024**	**5.0**		**CIRC**	**IR13**	**IR18**
IR15	**251**	**0.00429**	**0.080**	**30.0**	**8.0**	**TRAP**	**IR15**	**IR16**
IR16								
IR17								
IR18	**1441**	**0.00524**	**0.0500**	**10.0**	**1.0**	**TRAP**	**IR18**	**A4**
J01	**11723**	**0.00971**	**0.0500**	**10.0**	**1.0**	**TRAP**	**A4**	**A5**
J02	**6876**	**0.00856**	**0.0500**	**20.0**	**1.0**	**TRAP**	**A5**	**A6**
K	**5007**	**0.00017**	**0.0150**	**30.0**	**1.0**	**TRAP**	**A6**	**A7**
L								
M	**1400**	**0.01840**	**0.0250**	**7.0**	**0.5**	**TRAP**	**B1**	**B2**
N	**10176**	**0.00332**	**0.015**	**10.0**	**1.0**	**TRAP**	**B4**	**B5**
O								
P								
Q	**9941**	**0.01220**	**0.0500**	**10.0**	**1.0**	**TRAP**	**M1**	**M2**
R								
S	**5114**	**0.00823**	**0.0140**	**10.0**	**1.0**	**TRAP**	**M3**	**M4**
T1	**4939**	**0.00573**	**0.015**	**10.0**	**1.0**	**TRAP**	**M5**	**M7**
T2	**2956**	**0.00669**	**0.011**	**10.0**	**0.0**	**TRAP**	**M6**	**M7**
T3	**2130**	**0.00340**	**0.02**	**25.0**	**0.0**	**TRAP**	**M8**	**M9**
U	**8192**	**0.00243**	**0.02**	**25.0**	**1.5**	**TRAP**	**M9**	**M10**
V								

APPENDIX B

STEVENS CREEK AND PERMANENTE CREEK HYDROLOGY INFORMATION

The following Table shows the design flows for Stevens Creek and Permanente creek at various catch points using the procedures as presented in this report:

Design Flows for Stevens Creek and Permanente Creek

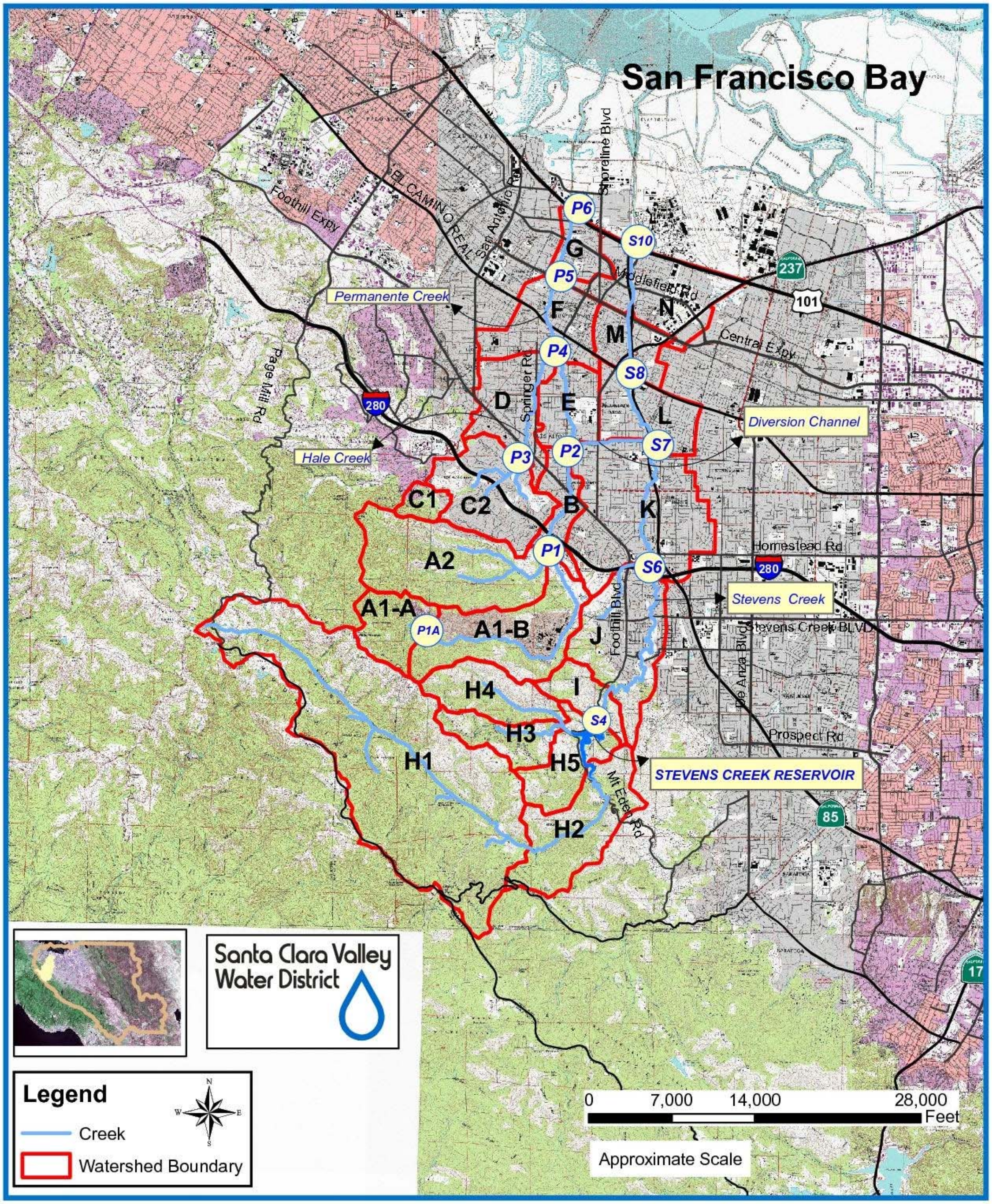
Location	Drainage Area mi^2	PEAK FLOW (cfs)					
		2.33 year(*) Q 43%	5 year(*) Q 20%	10 year Q 10%	25 year(*) Q 4%	50 year(*) Q 2%	100 year Q 1%
Stevens Creek u/s Reservoir	**17.26**	**1,300**	**2,300**	**3,100**	**4,200**	**4,900**	**5,700**
Stevens Creek d/s Reservoir(S4)	**17.26**	**1,300**	**2,200**	**3,000**	**4,000**	**4,800**	**5,500**
Stevens Creek @ I-280(S6)	**20.69**	**1,400**	**2,400**	**3,200**	**4,300**	**5,100**	**5,900**
West Branch Permanente Creek	**3.51**	**140**	**270**	**400**	**590**	**730**	**880**
Upper Permanente Creek u/s West Branch Permanente Creek(P1A)	**1.17**	**230**	**330**	**400**	**490**	**550**	**600**
Lower Permanente Creek u/s West Branch Permanente Creek	**2.84**	**290**	**480**	**630**	**830**	**960**	**1,100**
Permanente Creek u/s West Branch Permanente Creek(P1)	**4.01**	**450**	**730**	**970**	**1,300**	**1,500**	**1,700**
Permanente Creek d/s West Branch Permanente Creek	**7.52**	**630**	**1,000**	**1,400**	**1,900**	**2,200**	**2,500**
Permanente Creek @ Diversion(P2)	**8.41**	**670**	**1,100**	**1,500**	**2,000**	**2,400**	**2,700**
Permanente Diversion to Stevens Creek		**790**	**1,000**	**1,100**	**1,200**	**1,300**	**1,400**
Stevens Creek d/s Diversion(S7)	**24.92**	**2,200**	**3,400**	**4,500**	**5,800**	**6,800**	**7,700**
Stevens Creek @El Camino Real(S8)	**26.49**	**2,200**	**3,500**	**4,600**	**5,900**	**6,900**	**7,800**
Stevens Creek @ US 101(S10)	**29.79**	**2,500**	**3,800**	**4,900**	**6,300**	**7,200**	**8,100**
Permanente Creek u/s Hale Creek	**9.60**	**110**	**280**	**480**	**810**	**1,100**	**1,400**
Hale Creek @ Fremont S.C. #33(P3)	**2.70**	**210**	**340**	**460**	**610**	**720**	**830**
Hale Creek u/s Permanente Creek	**4.39**	**340**	**520**	**670**	**850**	**1,000**	**1,100**
Permanente Creek d/s Hale Creek(P4)	**13.98**	**300**	**630**	**970**	**1,500**	**1,900**	**2,300**
Permanente Creek @ Central Expy(P5)	**15.76**	**360**	**730**	**1,100**	**1,600**	**2,100**	**2,500**
Permanente Creek @ US 101(P6)	**16.53**	**420**	**810**	**1,200**	**1,700**	**2,200**	**2,600**

(*) extrapolated and interpolated by using log Pearson Type III distribution.

- The initial storage for Stevens Creek Reservoir was at 3,138 acre-feet for both 1% and 10% design flow calculation.
- The highlighted flowrates are the design flows for the projects completed or underway recently.

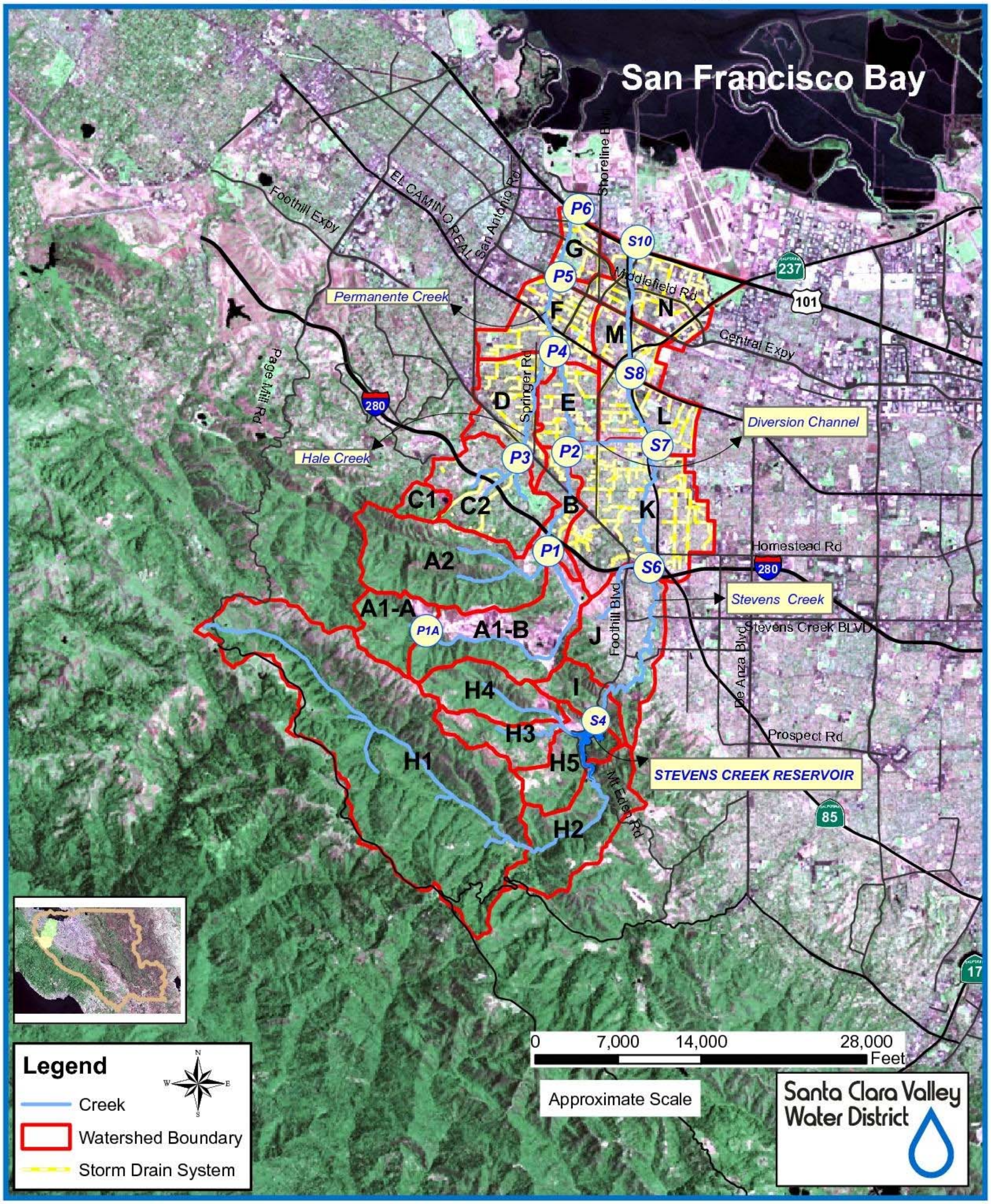
Watershed Boundary

Stevens and Permanente Creeks



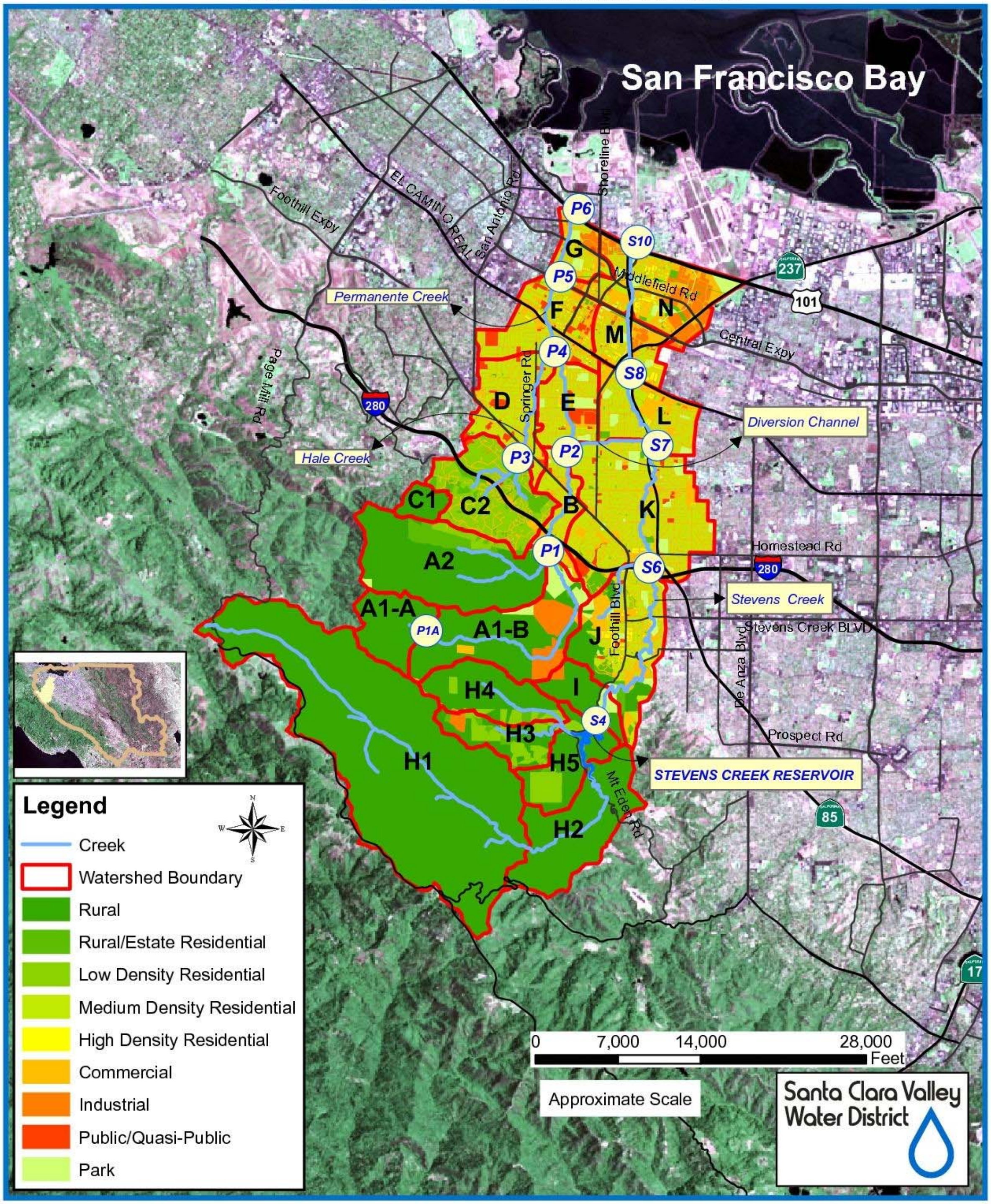
Storm Drain System

Stevens and Permanente Creeks



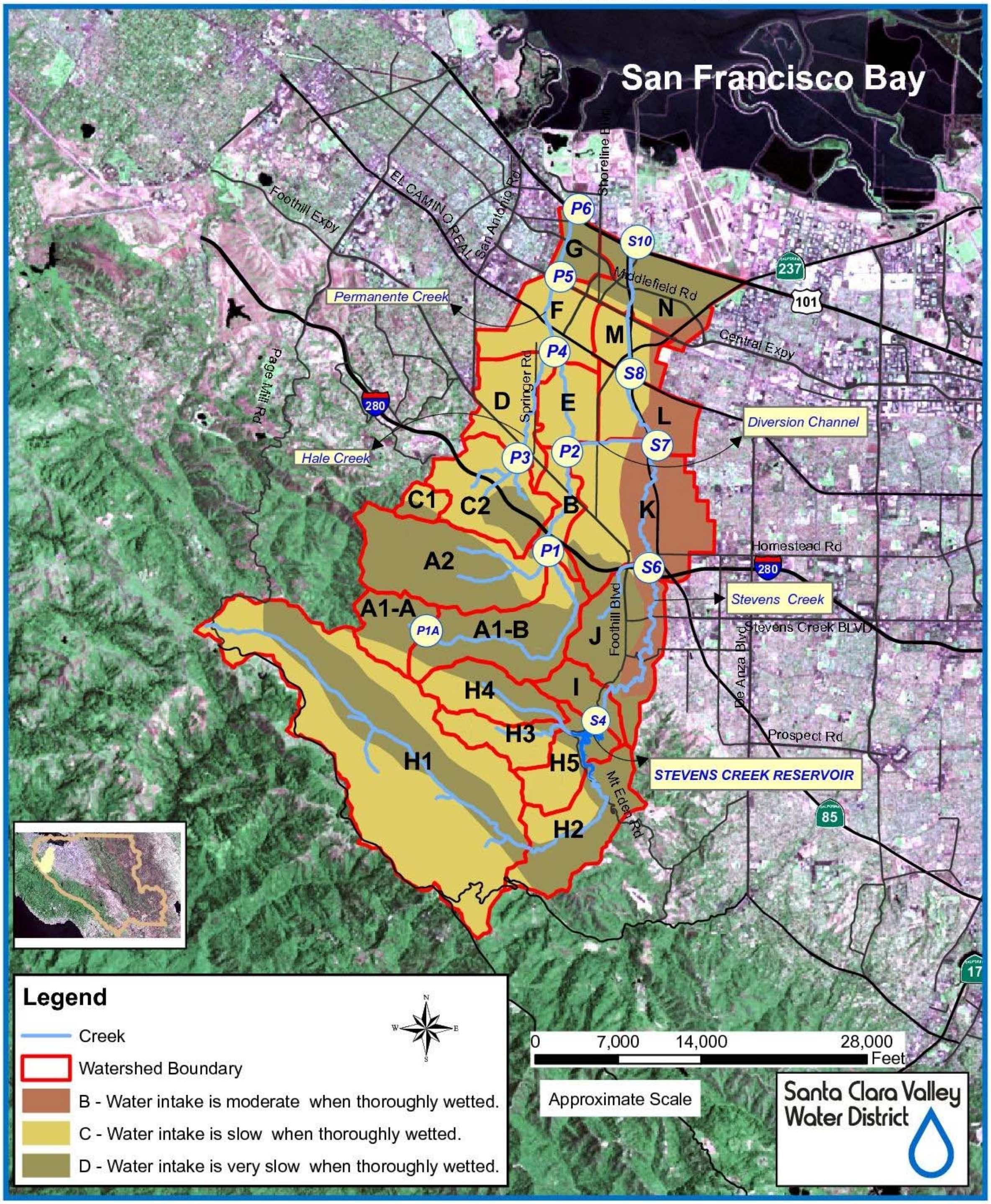
Land Use

Stevens and Permanente Creeks



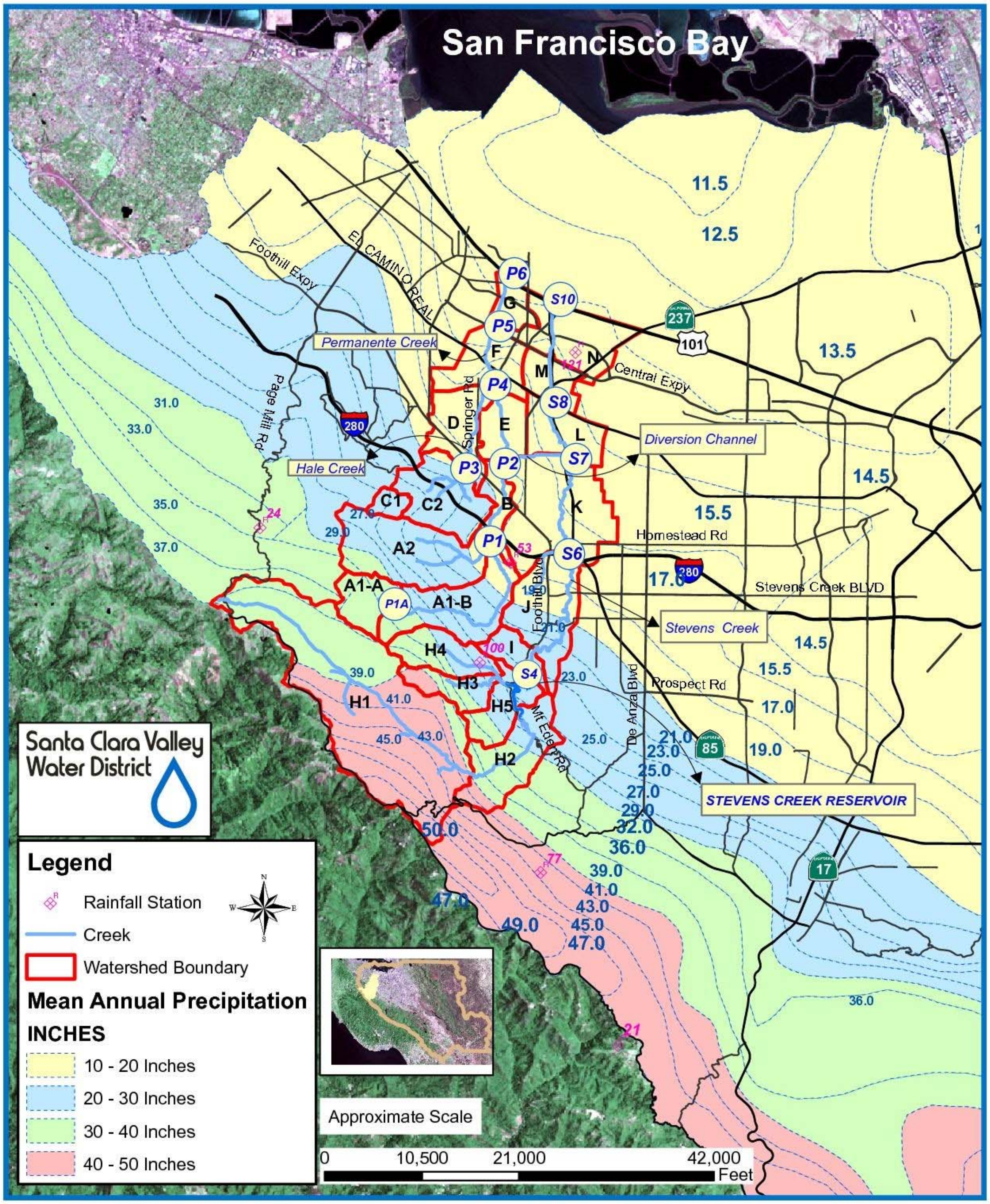
Soil Type

Stevens and Permanente Creeks



Mean Annual Precipitation

Stevens and Permanente Creeks



Stevens and Permante Creek (1% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall using Global Eq.	Applied Weighted Rainfall	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A1-A	1.17	1.17			0.50	80					0.47	0.76					9.52	9.10	2.25
A1-B	2.84	1.95	0.31	0.57	0.50	80	0.32	86	0.04	98	0.53	0.87	0.34	0.56	0.22	0.15	6.84	6.86	2.25
A2	3.51	2.97	0.40	0.13	0.62	76	0.42	83	0.04	98	0.66	2.66	0.45	1.82	0.21	0.14	6.79	6.67	2.25
B	0.89		0.27	0.62			0.56	78	0.04	98			0.40	0.93	0.24	0.16	5.20	5.42	2.25
E	1.19		0.36	0.83			0.56	78	0.04	98			0.39	0.90	0.24	0.16	4.83	5.00	2.25
C1	0.37	0.37			0.76	73					0.23	1.05					6.79	5.92	2.25
C2	2.33		1.40	0.93			0.50	80	0.04	98			0.36	1.64	0.20	0.13	5.88	5.92	2.25
D	1.69		0.42	1.26			0.56	78	0.04	98			0.35	2.56	0.23	0.15	4.98	5.12	2.25
F	1.78		0.36	1.42			0.56	78	0.04	98			0.36	0.85	0.24	0.16	4.63	4.74	2.25
G	0.77		0.19	0.58			0.42	83	0.04	98			0.42	0.97	0.25	0.17	4.30	4.48	2.25
H1	10.93	10.93			0.76	73					1.21	4.82					11.66	11.25	2.25
H2	2.44	2.44			0.65	75					0.92	3.68					8.80	9.10	2.25
H3	1.05	0.52	0.31	0.21	0.88	70	0.53	79	0.04	98	0.48	1.92	0.32	1.28	0.20	0.13	9.39	9.10	2.25
H4	1.50	1.22	0.18	0.10	0.72	74	0.48	81	0.04	98	0.44	1.77	0.39	1.56	0.21	0.14	8.53	9.10	2.25
H5	1.34	1.02	0.23	0.10	0.72	74	0.53	79	0.04	98	0.34	1.35	0.40	1.61	0.21	0.14	7.60	7.70	2.25
I	0.81	0.64	0.10	0.06	0.59	77	0.40	84	0.04	98	0.45	8.63	0.42	7.91	0.22	0.15	6.35	6.30	2.25
J	2.63	0.53	0.74	1.37	0.72	74	0.59	77	0.04	98	0.60	11.48	0.32	6.15	0.21	0.14	5.50	5.23	2.25
K	4.23		1.27	2.96			0.80	72	0.04	98			0.38	7.29	0.23	0.16	4.78	4.74	2.25
L	1.57		0.39	1.18			0.80	72	0.04	98			0.40	7.59	0.25	0.16	4.59	4.74	2.25
M	1.02		0.25	0.76			0.62	76	0.04	98			0.38	7.27	0.24	0.16	4.55	4.74	2.25
N	2.28		0.46	1.82			0.48	81	0.04	98			0.38	7.26	0.25	0.16	4.35	4.16	2.25

1. Total area of the sub-watershed in square miles
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6. Curve Number(CN) for rural area
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16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Stevens and Permante Creek (10% HEC-1 Input Data)

BASIN	Total Area	Rural Area	Perv Area	Imp. Area	Rural Ia -Calc	Rural CN	Perv Ia -Calc	Perv CN	Imp Ia -Calc	Imp CN	Rural Tc	Rural R	Perv Tc	Perv R	Imp Tc	Imp R	Rainfall using Global Eq.	Applied Weighted	AMC
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
A1-A	1.17	1.17			0.99	67					0.47	0.47					6.48	7.05	1.5
A1-B	2.84	1.95	0.31	0.57	0.99	67	0.68	75	0.04	98	0.53	0.53	0.34	0.34	0.22	0.15	4.65	4.87	1.5
A2	3.51	2.97	0.40	0.13	1.21	62	0.86	70	0.04	98	0.66	1.99	0.45	1.36	0.21	0.14	4.62	4.85	1.5
B	0.89		0.27	0.62			1.09	65	0.04	98			0.40	0.93	0.24	0.16	3.54	3.98	1.5
E	1.19		0.36	0.83			1.09	65	0.04	98			0.39	0.90	0.24	0.16	3.29	3.44	1.5
C1	0.37	0.37			1.45	58					0.23	1.05					4.62	4.06	1.5
C2	2.33		1.40	0.93			0.99	67	0.04	98			0.36	1.64	0.20	0.13	4.01	4.06	1.5
D	1.69		0.42	1.26			1.09	65	0.04	98			0.35	2.56	0.23	0.15	3.39	3.41	1.5
F	1.78		0.36	1.42			1.09	65	0.04	98			0.36	0.85	0.24	0.16	3.15	3.26	1.5
G	0.77		0.19	0.58			0.86	70	0.04	98			0.42	0.97	0.25	0.17	2.92	3.09	1.5
H1	10.93	10.93			1.17	63					1.21	4.82					7.94	7.98	1.75
H2	2.44	2.44			1.03	66					0.92	3.68					5.99	7.05	1.75
H3	1.05	0.52	0.31	0.21	1.33	60	0.84	71	0.04	98	0.48	1.92	0.32	1.28	0.20	0.13	6.39	7.05	1.75
H4	1.50	1.22	0.18	0.10	1.13	64	0.76	73	0.04	98	0.44	1.77	0.39	1.56	0.21	0.14	5.80	7.05	1.75
H5	1.34	1.02	0.23	0.10	1.13	64	0.84	71	0.04	98	0.34	1.35	0.40	1.61	0.21	0.14	5.18	5.69	1.75
I	0.81	0.64	0.10	0.06	0.93	68	0.65	76	0.04	98	0.45	8.63	0.42	7.91	0.22	0.15	4.32	4.32	1.75
J	2.63	0.53	0.74	1.37	1.13	64	0.93	68	0.04	98	0.60	11.48	0.32	6.15	0.21	0.14	3.75	3.71	1.75
K	4.23		1.27	2.96			1.23	62	0.04	98			0.38	7.29	0.23	0.16	3.26	3.26	1.75
L	1.57		0.39	1.18			1.23	62	0.04	98			0.40	7.59	0.25	0.16	3.12	3.26	1.75
M	1.02		0.25	0.76			0.98	67	0.04	98			0.38	7.27	0.24	0.16	3.10	3.26	1.75
N	2.28		0.46	1.82			0.76	73	0.04	98			0.38	7.26	0.25	0.16	2.96	3.10	1.75

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14. Clark's Storage Routing Coefficient R for pervious area
15. Times of Concentration(Tc) for impervious area
16. Clark's Storage Routing Coefficient R for impervious area
17. Rainfall using Global Equation in inches
18. Applied Weighted Rainfall in inches
19. Antecedent Moisture Condition

Channel Routing Parameters

BASIN	Channel Length (ft)	Channel Slope	Manning's n	Channel Width (ft)	Channel Side Slope	Channel Shape	FROM	TO
A1-A	22970	0.05233	0.062	8.6	1.0	TRAP	P1A	P1
A1-B								
A2	10013	0.01032	0.057	12.0	1.5	TRAP	P1	P2
B	8375	0.00764	0.055	5.0	1.0	TRAP	P2	P4
E								
C1	8569	0.02421	0.044	6.4	1.0	TRAP	P21	P3
C2	10078	0.00606	0.021	10.0	1.0	TRAP	P3	P4
D	6845	0.00747	0.012	11.0	1.0	TRAP	P4	P5
F	6089	0.00552	0.014	12.0	1.0	TRAP	P5	P6
G								
H1	14063	0.02432	0.063	25.0	2.0	TRAP	S1	S2
H2								
H3								
H4								
H5	2892	0.02168	0.057	25.0	1.5	TRAP	S4	S5
I	18078	0.00758	0.050	11.0	1.5	TRAP	S5	S6
J	13847	0.00749	0.037	15.0	1.5	TRAP	S6	S7
K	6536	0.00868	0.044	19.0	1.0	TRAP	S7	S8
L	5325	0.01000	0.029	18.0	1.0	TRAP	S8	S9
M	5667	0.00852	0.026	23.0	1.0	TRAP	S9	S10
N								